

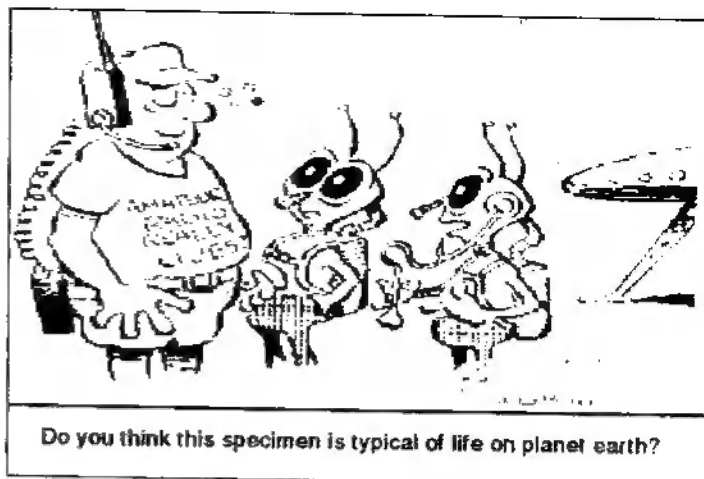
MIDSTATE AMATEUR RADIO CLUB

MARC

Ham Radio News from Central Indiana

Volume X No. 10 October 1994

JOHN H. HARRIS W1JH 1000 N. 10th St. Indianapolis, IN 46204 317-634-1111	JOHN H. HARRIS W1JH 1000 N. 10th St. Indianapolis, IN 46204 317-634-1111	JOHN H. HARRIS W1JH 1000 N. 10th St. Indianapolis, IN 46204 317-634-1111	JOHN H. HARRIS W1JH 1000 N. 10th St. Indianapolis, IN 46204 317-634-1111	JOHN H. HARRIS W1JH 1000 N. 10th St. Indianapolis, IN 46204 317-634-1111
--	--	--	--	--



Upgrades at September testing:

Tim M. Crafton	Gosport	Tech
Amy Lacy	Columnus	Tech
Paul Roman KA9PPG *	Franklin	Tech +
Ruth Sheeler	Indianapolis	General
Lloyd Sloan	Greenwood	Tech

* indicates member of MARC

Mighty 525 to have rebirth

The "Mighty 525" may be headed back to its former status as the wide-area repeater of central Indiana! Bob Hawkins, WA8VZY has indicated that the "big one" is due for a rebirth under the call sign of Martin Hensley KA9PCT.

Details of the move are still rather vague, but former members are being contacted as possible renewals. We'll try to keep you posted.

DSP program

DSP, digital signal processing! It's the latest audio processing technology to sweep the amateur radio market! But, just how much do we understand the technology that is supposed to give us clearer, sharper audio?

John Scott, WM9U, will address that topic at the October meeting of the Mid-state ARC. He will demonstrate the difference of processed and unprocessed audio using the latest DSP equipment and techniques available.

FCC installs a new 800 phone for amateurs

The FCC has instituted a toll-free phone line at its Gettysburg, Pennsylvania licensing division for customer service inquiries.

Amateurs may call 800-322-1117 weekdays between 8 AM and 4:30 PM Eastern Time to access an automated information system with recorded messages on interference complaints, form requests, records, and Amateur Radio call sign assignments.

Other messages regard fee information and processing times. A TouchTone telephone is required.

The FCC said the new service was part of its response to a presidential order that the federal government be "customer driven." The FCC said it used a series of focus groups with external customers to identify the desire for an 800 number at its licensing division.

"Within the next 18 months," the FCC said, "customer service standards will be developed for other areas of Commission operations to ensure that FCC customers receive the highest quality of service possible. As these new standards become available, the FCC will inform its customers."

from WIAW ARRL Bulletin 74 From ARRL Headquarters Newington CT September 22, 1994.

BENS WEATHER TIPS

We're at a time of year that lots of fearless forecasts are issued for the approaching winter. You'll see all kinds of "weather indicators" used for making snowfall and temperature forecasts.

Some of the more commonly used indicators are: wooly worms, persimmon seeds, wind data from the autumnal equinox, walnut tree leaves and so on.

Be assured weather DOES affect many of these indicators. However, they have only been shown to be reliable at showing what the weather HAS BEEN not what it WILL BE.

For example, legend tells us when the wooly worms are light in color (like they are this year) we will have a relatively mild winter.

Dark wooly worms (or at least dark bands) indicate a harsh winter. Actually, wooly worm markings are altered by temperature swings during the summer and fall. The wooly worms accuracy rating as a FORECASTER is about 50 percent (same as flipping a coin).

Take careful note of the way many articles and magazines state their forecasts. Many are vague. Of course, the winter will be cold, and yes it's bound to snow sometime. Even the Farmer's Almanac rarely gets very specific with its forecasts. After all this, let me just throw in MY forecast. Be advised it is based

CURRAN ELECTRONICS SALES AND SERVICE

We repair most brands of amateur, business band, CB's, and scanners.

Tom Curran N9DZJ

1217 N. Wittfield St. Indianapolis 46229
Phone 898-2338 Fax 898-2338

YAESU KENWOOD ICOM
ALINCO STANDARD

R & L

Electronics

The "Candy" Store for
Central Indiana Hams!

8524 E. Washington St. Indianapolis 46219

Phone: (317) 897-7362

1-(800) 524-4889 Fax (317) 898-3027

on gut feeling and little meteorological facts. The winter will begin with lots of snow and cold weather (especially in Dec.), a relatively mild January, a cold February and a snowy March. There. I guess I'm committed now.

Before we get any snow, let's not overlook the fall color show. October is a colorful month in Indiana with the leaves going through their fall-color change. It can be a wonderful month weather-wise but at the same time very changeable. Last month was a fairly typical September in Indianapolis.

We started October with near record warmth. October 1st high temperature in the capital city was 86. We've settled into a more typical fall weather pattern since then. The outlook for October calls for near normal temperatures and above normal rainfall.

MARC

Mid-State Amateur Radio Club

Post Office Box 836 Franklin, In. 46131

Club Repeater: 146.835

President: Randy Shake KC9LC

V. President: David Reneau AA9KT

Secretary: Marilyn Parton N9TUK

Treasurer: Mac McCarty NV9K

Editor: Mac McCarty NV9K

RACES: Joe Vergara KA9ZPA

ARES: Vernon Gill N9QBO

Activities: Jack Parker NT9J

Rpts. Trustee: Dave Julian WR9YIG

Weather: Ben Woods Channel 8



New portable antenna ready for the club

Thanks to Tim Sanford, N9XNP, the Mid-state ARC has a new portable antenna mast and base unit. The quick assembly kit includes two ten-foot sections of mast on a roof-top tripod.

Tim put all the parts together for the 8K Run in Flatrock, Indiana in August. At that time a clamp was used to hold a mag-mount 2-meter antenna on the top of the mast. This served as the base radio antenna for the marathon's net control.

Tim plans to develop a quick-assembly weight system for holding the tripod in place during windy conditions. As it stands now, the mast sections and tripod are ready to be used. With the club's Isopole antenna we

are ready in case of an emergency or for another quick and dirty field project!

If you have any ideas or materials that would help augment this project contact Tim or one of the club officers.

Remember the picnic?

It was a day of fun for the whole family. About forty club members and their families climbed aboard the miniature trains and rode the rails through Northern Morgan county September 17th.

The occasion was the second annual Mid-state ARC family picnic and club meeting. Each member brought a covered dish to share. Sliced ham was provided by the club.

Pat Pyle's famous "floor mat

chili" was a huge success as late summer temperatures turned cool for the day.

Ron Gaertner, WB9NVM, kept busy hauling one load of hams after another around the 3/4 mile layout. His 1/8th scale Amtrack diesel engine easily pulled the loaded passenger cars through the hills and hollows of the Morgan county train park.

If you would like to visit Mt. Nebo station, contact Ron, Bob Cammack, N9IMP or Bruce McClary, KA9AWW, for more information. The next train leaves Mt. Nebo station Saturday, October 15th.

Taxes, taxes

Tax his cow and tax his goat, tax his pants, tax his coat, tax his crop and tax his work, tax his tie and tax his shirt, tax his chew and tax his smoke- teach him taxes are no joke.

Tax his tractor, tax his mule, teach him taxes are the rule. Tax his oil, tax his gas, tax his notes, tax his cash, tax him good, then let him go- only when he has no dough.

If he hollers, tax him more, tax him till he's good and sore. Tax his coffin, tax his grave, tax the sod in which he's laid. Then put these words upon his tomb: *Taxes drove me to my doom!*

But even dead he can't relax, make him pay non-survivors tax!

from the July 94 American Airlines ARC "Haam Happenings"- Don Feigel, WD5EHU, editor.



*** The actor was well known for being a great dresser. His suits were of fine Italian silk and hand-made. Unfortunately, he never paid his tailor.

Another actor asked the tailor why he extended credit to the deadbeat.

The tailor said, "He must have money. Look at the way he dresses!"

*** Dead owls don't give a hoot.

*** So Adam and Eve are sitting around Eden when a leaf floats down from a tree. Eve points and says, "Adam, look! An invisible man!"

*** You're getting old when you paint the town red and have to take a long nap before you put on a second coat.

*** Some airlines are now putting mistletoe at the baggage counter. That way you can kiss your luggage good-bye.

*** Noah says to two snakes when they finally reach land, "Didn't I tell you to go forth and multiply?" One of the snake said, "We can't. We're adders."

*** An antique is a household object that's made a round trip to the attic.

*** "What was your last job?"

"I cleaned out a bank."

"Janitor or president?"

*** A man tells the waiter in a restaurant, "I love food, but most of all I love bread. I must have bread."

The waiter brings him two thick slices of bread, which the man devours. The man says, "I like the food but I must have more bread!"

The next day the waiter brings him four slices of bread. The day after, five slices are put before him. The man still complains. Finally, the waiter takes a giant loaf of bread, cuts it in two, and puts it down before the man, who sneers and says, "Why did you go back to two slices?"

*** He was in World War II. He shot down six planes, captured ten officers, and blew up an ammunition dump. That may explain why he was shipped out of Cleveland.

*** He's not bald. He's just taller than his hair.

*** A joint account is never overdrawn by the wife. It's just underdeposited by the husband.

*** The doctor told him to bathe in some of the famous springs. So he took one in the spring of 1985.

*** Nothing helps a woman's looks more than a nearsighted man.

*** A Texan visits California, picks up a watermelon, and says, "Is that the biggest grapefruit you've got?"

The Californian nearby says, "Please, sir, you're crushing that raisin!"

*** He's so cheap - in his guest room he has a pay smoke alarm.

*** They say that an Indy 500 pit crew can get the tires off a car in forty seconds. If they think that's fast they've never been in Manhattan.

*** It had to happen sometime! Our company computers are now talking Union!

*** "What's the opposite of progress?" "Congress!"

*** A man is brought in for stealing a pair of shoes. The judge says, "Weren't you here last year for the same charge?"

The man says, "Your Honor, how long can a pair of shoes last?"

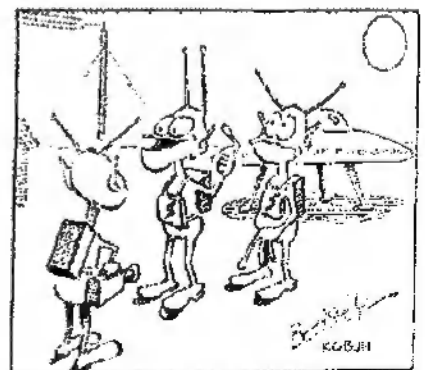
*** There's one thing about kleptomania - you can always take something for it.

*** A bank robber shoves a note under the cage gate to the teller. It says, *Put the money in the bag, and don't try anything funny.* The teller sends back a note: *Straighten your tie. They're taking your picture.*

*** It's so dry here in the desert that for baptisms we just use a damp cloth.

*** "Doctor, you charged me fifty dollars, and all you did was paint my throat."

"What do you want for fifty dollars, wallpaper?"



I JUST MET SOME EARTHLING MAN - HE TOLD ME TO STAND THESE STRAIGHT UP AND THEY'LL ACT LIKE A "WASSED ARROYO"!

Balloon launch in October

Grab your 440 DFing equipment and head for Lebanon, Indiana. This Sunday another phase of Wind Trax '94 will take to the skies over the hoosier state.

According to Chuck Crist, WB9IHS, the 105K balloon is being launched from the Boone County area so the fox hunters will have a chance to chase the balloon through central Indiana and western Ohio. Previous launches from Indianapolis have taken the DFers into the hilly areas of southeastern Indiana.

Lift off is set for 7 am or 1200 hours UTC, October 16th. Chuck says everyone is welcome to follow the balloon's progress by tuning to the 2 meter/70 cm crossband repeater. The input will be 144.300 and the output is 440.90.

The four pound payload will consist of the crossband repeater, a 1.2 gigahertz ATV transmitter with camera, a GPS unit and a packet data transmitter.

Even if you don't have a 440 directional finding antenna, you can follow the action via the onboard repeater and help retrieve the payload package after it returns to earth.

But, come prepared. Past recoveries have been made from dense corn fields and wooded tree top perches. It's a fun way to spend a Sunday.

Pack a picnic basket, grab your

radio and bring the YL for an action filled day through the colorful Indiana countryside.-NT9J.



Sparky and the ozone holes

by Dick McKlveen, W4YWA

Not long ago, at a local watering hole, I met my old friend Sparky Corona, who has been a Novice Class ham for as long as I can remember. He appeared to be relaxed, but his appearance was deceiving. Sparky was worried about those gaping holes in the ozone layer.

"Everyone is upset about a few holes in the ozone layer, but they are ignoring the real threat," Sparky said. "The real problem is the huge multitude of faults in the ionosphere."

Sparky's revelation startled me, so I ordered a beer and asked him to explain. My invitation must have been what Sparky was looking for, because he proceeded with abandon.

"You must know that band conditions have been lousy lately. Just yesterday I lost a 7J6 and a BY1 for no apparent reason. Over the past month I lost at least fifty contacts before we could even exchange signal reports. And stations I manage to latch onto faded from S-9 to 0 faster than I could crank up the gain! How is a

guy supposed to get WAS, not to mention DXCC, with this sort of thing happening?"

"Darned if I know," I interjected.

"Well, I figured it out. The darned rockets, shuttles, and other silly gadgets that are being shot into space are punching humongous holes in our ionosphere. If you have ever watched a launch, you know what I'm driving at. The flame from one of those gadgets would crisp an elephant at 5,000 yards in seconds. They are ripping holes in our precious E and F layers!"

I was stunned to silence, not that Sparky noticed. "Instead of bouncing back to earth as they should, even kilowatt signals barrel right through those holes. Maybe little green men up there are reading our signals, but they aren't in the habit of QSLing."

I mumbled that the damage might not be as serious or permanent as he imagined, and that the ionosphere might heal itself through some process similar to osmosis.

"That's easy for you to say; all you do is talk to locals on the 2-meter repeater," Sparky retorted.

He was too upset for small talk so, to console him, I suggested he take up satellite communications. That way, he could take advantage of those gaping holes. I even called Sparky later, to give him the address of AMSAT.

I saw him again yesterday, and he seemed more relaxed.

from the June 94 "Spurious Emissions" - W4YWA
Editor.

10/94

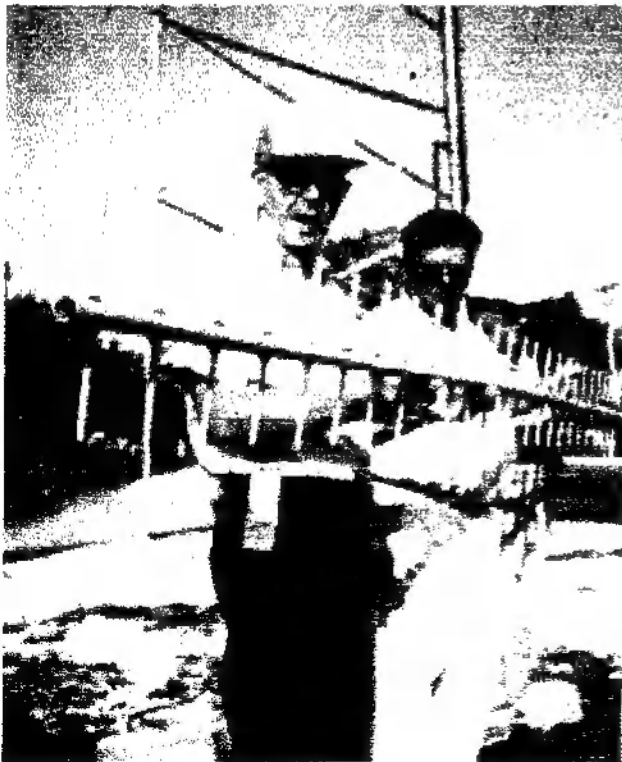
Tower Work at the E. O. C.



J.R., KB9HSE and Steve N9NZI do some ground work on the antenna.



Dave, AA9KT and Bill KA9ZMU try some "6 foot DX" for tower to ground communications.



The ATV antenna gets some repair work by J.R., KB9HSE, Joe KA9ZPA, and Steve N9NZI.



The Franklin Fire Department shows, "There's only one way to work on a tower!"

Slow Scan TV

by Marc Grant N5MEI

Slow Scan Television has been around for a few decades but it never got very much attention. The reason is that commercial equipment was very expensive and it was much too complicated for most people to homebrew.

The situation has changed radically in recent years. Rather than using expensive special purpose hardware, most of the newer systems are using personal computers to do most of the work.

There is now a wide assortment of free software that uses very simple interfaces and ready-to-use commercial systems at affordable prices. New people are showing up on SSTV everyday.

Although SSTV activity has exploded during the last couple of years, it's still hard to find much modern information. The most recent SSTV handbook published in the U.S. (that I know of) is now almost 20 years old! Technology has changed quite a bit since then.

Here is one of my attempts to help combat this lack of information. This article contains some background on SSTV, and pointers to other sources of information.

As with anything else, there are some good products available and some real junk being sold with deceptive advertising. Just get on the air and ask what people are using and how they like it. Caveat emptor!

There are several different ways

to send images over ham radio:

1. RTTY art - Remember when people made pictures from characters?

2. FSTV (Fast Scan TV - Also called ATV) - Similar to broadcast TV. Full motion, color, sound, etc. Restricted to UHF and up because a signal requires several MHz of bandwidth.

3. WEFAX (weather facsimile) - Very high resolution gray scale images sent by audio tones over a period of minutes.

4. SSTV (Slow Scan TV) - Low to medium resolution still images sent through audio channels over a period of several seconds to a few minutes. Mostly color these days.

5. Digital SSTV - We have the technology but I haven't seen any proposals yet.

Frequencies

By convention, SSTV operation is generally found on only a few frequencies:

3.845, 3.857, 7.171, 14.230, 14.233, 21.340, 28.680, and 144.5

Nets: Two different Slow Scan nets meet on Saturdays at 15:00 and 18:00 UTC on 14.230 MHz.

Digital Signal Processing

Digital Signal Processing (DSP) could be the next major breakthrough in improving SSTV reception while maintaining compatibility with existing equipment. DSP uses an Analog to Digital (A/D) converter to sample the audio signal. After that it's all software.

DSP can simulate analog circuitry

or do types of processing not even possible with the analog approach. DSP isn't magic and it doesn't guarantee superior performance. It all depends on the skill of the person writing the DSP software.

Wyman Research, a major manufacturer of FSTV equipment, showed a prototype system at the Dayton '93 SSTV Forum. We are all anxiously awaiting more information on progress.

Free Software

There are several free SSTV programs available that will receive, and perhaps transmit, with very simple interfaces. Look around the ARRL BBS (phone (203) 666 0578 or the ham radio sections of other on-line services or BBSs.

Look for file names resembling: JVFAX???.ZIP, SLOWSCAN.ZIP, SSTVDEM?.ZIP, SSTVFAX2.ZIP, and VESTER.ZIP.

Naturally, these don't offer all the features of some of the commercial systems but they are a wonderful way to get a taste of SSTV with little or no cost.

Conclusion

Most hams are scared away from trying SSTV because they still think it HAS TO be expensive. That WAS true but not anymore. SSTV activity has exploded in the last year with the introduction of low cost IBM PC-based SSTV systems.

edited and paraphrase from a packet bulletin by N5MEI dated April 1994.



Don, N9BGW, and Bob N9IMP ride the rails at the picnic.

Mid-State will help Scouts

On Saturday October 15th at 9:30 several members of the Mid-State Amateur Radio Club will be participating in the Boy Scout Jamboree On The Air.

JOTA is an annual scouting amateur radio event sponsored by the World Organization of the Scout Movement. It's always held the 3rd full weekend of October. Thousand of stations around the globe participate, and if propagation is right it's common to contact as many as 100 scouting countries during the weekend!

If you are going to make contacts with JOTA call "CQ JOTA" and I am sure you'll have many scout people willing to talk to you.

We are sorry to report that Sarah, wife of Joe KF9LQ, passed away this week. We extend our sympathy to him and his family.

At our setup we are going to have several packs of Webelo Cub Scouts (boys 11 to 13 years old). We plan to let them operate and to answer any questions they might have. Hopefully we might spark an interest in Amateur Radio!

Further info will be available at the meeting October 15th.

-AA9KT

Do you know this Marc club member?



Last month's mystery club member was Bill Brinkmann KA9ZMU



It's time again for the annual patrol!

Vernon Gill N9QBO, our club RACES officer, has announced that the club will again participate with the Johnson County Sheriff's department in the annual "Pumpkin patrol."

The dates have been set for Sunday October 30 and Monday October 31. Times are set at 6 to 9 PM both nights.

The Mid-State club has been participating in this event for several years. Amateurs helping with the patrol serve as additional "eyes and ears" for the sheriff's department during this time of increased vandalism.

If you can help this year, check-in with Vernon by the next club meeting. He will need to know the make, year, and license number of the car you will be using.



FCC bans all duckies!

In a surprise move today, the Federal Communications Commission banned the use of rubber duckies by Amateur Radio operators. As the reason for the unusual ruling, FCC Chairman James Juello said, "In a two-year investigation, we found the Amateur bands getting ever more crowded with irresponsible operators who violate the Communications Act and transmit with total disregard of Amateur procedures." Juello said any Ham caught with a rubber duckie will lose his or her license.

Ed Hairless, speaking for the American Radio Relay League, said, "Research by psychologists and forensic psychiatrists hired by the League has unanimously concluded that Amateurs with rubber duckies or other waterfowl facsimiles in their bath tubs are too immature to hold licenses.

Reactions to the ruling by hams have been mixed. King Insain said, "When visiting the U.S., I usually have to share my royal swimming pool with a rubber swan, since it would take too long for my real swans to clear the U.S. Customs quarantine."

Former Arizona senator and presidential candidate Berry Col-dwater said, "Heck, I was hoping they'd forbid the antenna known as a rubber duckie. It would have been a perfect excuse to equip my HT with a rod antenna, which could also serve as an electric cattle prod

on Democrats' behinds."

The FCC has yet to announce its enforcement plans for the new rule, but Judd Slapback of the FCC's New York office says they expect to pay surprise visits to randomly selected hams early on Saturday evenings. "U.S. marshals with camcorders will accompany us. We hope to catch violators in the tub with the illegal devices."

Worried about backlash from environmentalists and military officers, the FCC has yet to decide whether to extend the ban to toy whales and submarines.

from the April '84 IBM ARC N4PYB Editor and ARNS

DX is!

By Ted Davis, W6BJH

Here we are at the bottom of another solar cycle. Some of us have seen quite a few solar minima; for others this the first.

We see long faces at club meetings and hear discouraging comments on HF propagation. And nature conspires against even the best efforts of the Palos Verdes Sun Dancers.

Not only is the solar flux low, the A-index shows big numbers. And just when the faithful see a slight drop in the A-index, the darn thing jumps way up again! What's a DXer to do?

Well, one unnecessary thing that works against us is the "Dead Band Syndrome." We remember too well, as young DX pups, Old

Timers telling us not to call CQ DX. That was sound advice when conditions were good. How often have you heard someone calling CQ DX right on a DX station's frequency?

But when band conditions are poor, it's another story. With all those listeners and no senders, there is nothing to hear. Gol-I-y!

The DX Packet Spotting Network aggravates the Dead Band Syndrome. The DXer takes one glance at the packet screen, notes the long hours with no DX announcements, and concludes the bands are dead. And hearing nothing in a quick band-scan confirms it.

But there are DX openings! It's just that you can't detect them when there is no one transmitting.

Breaking this impasse couldn't be simpler; just call CQ DX. Don't be afraid to transmit. If anyone complains, tell 'em I said it was okay!

Here's another idea. When the bands truly are blotto, work state-side DXers - all those guys who are, under good conditions, your competition. You can even invent games.

For example, work 100 DXers who have DXCC, or 300 who have 300 or more confirmed. This is a great way to combat the DX brain death lousy conditions can cause. My suggested procedure: call "CQ DXers."

So 73 and good DXing!

from the August '84 Northern California DX Club "DXer" and ARNS

10/94

How a balloon launch works

If you are interested in following the balloon launch on October 16th you might find the following article about typical launches interesting. It is from "Ballons at the Edge of Space" in the October issue of QST.

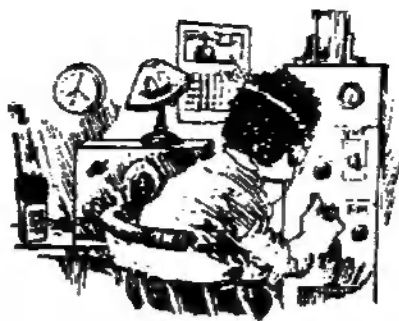
Optimist: Anyone who sends a package containing several hundred dollars worth of electronics 20+ miles above the ground with the sincere belief that he will see it again.

Some of these balloon packages contain only simple electronics such as a 2-meter beacon transmitter. Others tempt fate considerably with ATV transmitters, sophisticated telemetry, packet digipeaters, voice repeaters and so on.

One of the most attractive aspects of high-altitude ballooning is that it combines several areas of Amateur Radio. Direction-finding enthusiasts are needed to track the balloon during its flight and recovery. ATVers supply the know-how for sending and receiving video from the balloon. Packeteers are often involved in setting up balloon digipeaters, control systems and telemetry. HF-active hams run the tracking nets, usually on 40 meters.

Although you'll encounter an expert here and there, most of these men and women are average hams. They come together to enjoy the challenge of the flight - from payload assembly, to launch, to recovery.

The typical balloon payload is packaged in an insulated con-



tainer (average weight is 4 pounds or less). If there is an ATV camera on board, the lens may be pointed down through the bottom of the package, or out to the side. Some payloads use servo-controlled mirrors to obtain views from other angles. Antennas sprout from the package, along with the occasional sensor for heat, altitude or whatever.

As the balloon rises, the ground crew tracks the beacon, gathers telemetry or watches the spectacular video. The payload often twists rapidly, resulting in a spinning view of the Earth and clouds below.

The balloon is 6 to 10 feet wide on the ground, but it expands as atmospheric pressure diminishes. At 100,000 feet the balloon is the size of a small house! It can't expand forever, so it eventually bursts in spectacular fashion. The payload plunges back to Earth through the thin atmosphere. A recovery parachute is attached to the package and the air becomes dense enough for the 'chute to start working at about 70,000 feet.

The package drifts down slowly as the trackers scramble to anticipate its landing point (as much as 70 miles from the

launch site). Some balloons carry GPS receivers. By passing the GPS data over packet radio, the ground crew can plot the balloon's position at almost any moment. In addition, the position data can be transmitted in the APRS (Automatic Packet Reporting System) format. This allows any packet-active ham on the ground who has APRS software to follow the balloon's journey on a computer-generated map!

Marriage for local amateurs

It has been billed as the worst kept secret in ham radio. But, for two Columbus, Indiana amateur radio operators it was a match made in heaven.

Last month Paul Bartlett and Sarah Tolen tied the knot ending a five month radio romance.

Sarah, known to her friends as KA9EWT, had never used her novice privileges since getting the license in 1986. Earlier this year she upgraded to technician and broke the radio silence by making her first contact on 2-meters.

Her first contact was with Paul, N9TLF. That first contact left a lasting impression and blossomed into a 2-meter love affair. According to local friends they would often talk simplex, building a romance around their work schedules.

Congratulations to Mid-state ARC club members Sarah and Paul Bartlett on the occasion of their marriage. A match made in heaven or at least through the ionosphere.